Surveys

Wildfires in Poland: The impact of risk preferences and loss aversion on environmental choices

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ARTICLE INFO

ABSTRACT

This paper examines how risk preferences and loss aversion affect individual choices regarding environmental risks, specifically forest wildfires in Poland. We also examine how the same individuals make choices in the context of financial risks. Estimating risk, loss aversion and weighting probability parameters allows us to directly test whether Prospect Theory or Expected Utility Theory is the better underlying behavioural model in both domains. We find that in a sample consisting of a general population of Poles, the majority of respondents demonstrate behaviour consistent with Prospect Theory in both environmental and financial domains. This finding has significant implications for future non-market valuation studies. Additionally, in this study, we find evidence for similar risk preferences across those two domains.

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1. Introduction

The valuation of risky environmental goods is an area of non-market valuation that raises fundamental questions regarding respondent cognition and subsequent analysis as well as interpretation. While a growing body of evidence exists with respect to people's preferences about such goods – focussing, for example, on outcome uncertainty (Richardson and Loomis, 2009) or supply uncertainty (Rigby et al., 2011 or Rolfe and Windle, 2010) – many open questions remain. One important knowledge gap involves identifying the most appropriate behavioural model to guide analysis and ultimately improve the predictive powers of willingness-to-pay (WTP) models.

Standard economic analytical techniques assume Expected Utility Theory (EUT) as the underlying model in estimating WTP. If this assumption is inappropriate for risky environmental decisions, WTP estimations can be biased (Shaw and Woodward, 2008). A core assumption of EUT is that the risk preference function is linear in the outcome probabilities. However, in experimental situations individuals often do not

behave in a manner consistent with this theory, and they place too much weight on low-probability events and underweight high-probability events. This approach is more consistent with Prospect Theory (PT), a non-expected utility theory (NEUT) introduced by Kahneman and Tversky in 1979, which allows preferences for risky decisions to be nonlinear in both outcomes and probabilities. If people do not weight probabilities linearly, then the utility of a policy option should be calculated by multiplying the utility of a desired good by the decision weights associated with the policy outcome, instead of simply multiplying the utility of end-states by the probabilities of achieving the end-state (Roberts et al., 2008).

Shaw and Woodward (2008) stress that the limitations of EUT are often relevant for environmental problems as they are often high-consequence, low-probability events (e.g., natural catastrophes, exposure to toxics, or wildfires). If PT applies and probability weighting is excluded, then the social benefits of environmental programmes that offer low probabilities of large environmental improvements can be underestimated in non-market valuation studies (Riddel, 2012).

Roberts et al. (2008) noted that confounding the consistency of behaviour with NEUT leads to a conclusion that decision weights might be good and context specific. Domain effects may also affect risky

choices and may or may not change the degree of risk aversion that an individual displays in each domain. Economic theory makes no prediction with respect to the impact of context on a decision.[1]

A number of psychological studies, in particular Weber et al. (2002), have provided strong evidence that risk preferences are domain specific, but their findings only partially explain how respondents' fundamental risk preferences may influence their choices. Against this background, Riddel (2012) provided a framework for capturing environmental risk preferences in a way that allows environmental choices to be elicited, interpreted and analysed in the same way as risky financial choices. By eliciting a probability weighting function as well as a risk preference function, she was also able to establish that PT describes behaviour better than EUT.

The aim of this paper is fourfold. First, we investigate whether individuals' behaviour is more consistent with EUT or with NEUT in financial and environmental domains by adding more empirical evidence to the small number of studies that have so far investigated this issue in an environmental context. Second, we test whether preferences with regard to risks differ across the financial and the environmental domains. Third, we check whether risk preferences are heterogeneous across individuals. Additionally, we examine the results of two different risk aversion elicitation methods. The first allows inferring risk preferences based on individuals' choices in hypothetical games (Tanaka et al., 2010), and the second elicits risk attitudes based on self-reported engagement in risky situations in daily life (Weber et al., 2002).

The study is built upon the methodology proposed by Riddel (2012) and Tanaka et al. (2010). Risk preferences within the environmental domain are examined in the context of forest wildfires in Poland. The effects of natural disturbances, including wildfires, are often directly tied to efforts by government agencies to decrease the likelihood that a disturbance will occur and to mitigate negative consequences when it does take place. The main effects of forest wildfires in Poland are losses in biodiversity, changes to the landscape and reduced recreational opportunities. Although the vast majority of forest wildfires in Poland are single, small scale events, the negative externalities, when aggregated, could potentially generate significant welfare losses to the population at the national level.

Only a few studies so far have investigated risk preferences in the context of wildfires and those conducted have mainly used an indirect approach. For example, Wibbenmeyer et al. (2013) used a CE to measure attitudes of U.S. wildfire managers toward wildfire risk. They found that the managers' decisions are consistent with NEUT of decisions under risk; that is, the managers may over-allocate resources when the likelihood or the magnitude of potential fire damage is low. In a recent study Holmes et al. (2013) designed a CE study to estimate homeowners' WTP in the context of mitigation programmes that reduce the risks and economic losses from wildfires. They found that respondents' strategy for avoiding wildfire damage to their houses is consistent with PT.

To our knowledge, this is the first study focusing on risk preferences regarding forest wildfires in Europe and the first in which environmental outcomes from wildfire protection programmes are described as a public good. The remainder of the paper is as follows. The next section discusses theoretical and empirical methodological literature pertinent to this study. Section 3 describes the method used to define and elicit the relevant parameters. Section 4 details the survey and sample characteristics, while Section 4 contains the results of our analysis. Section 5 discusses these results and offers some observations on their implications for future stated preference survey design.

2. Related Literature

2.1. Prospect Theory and Risk Elicitation

Expected Utility Theory (von Neumann and Morgenstern, 1944) has long been the standard approach in economic modelling. This theory assumes that individuals do not have preferences for probabilities themselves, but only for the outcomes that are conditioned by probabilities. Additionally, individuals' risk attitude is assumed to be entirely associated with the marginal utility of a risky good, and marginal utility over outcomes is expected to be constant. However, an increasing number of studies document behaviour of individuals that is inconsistent with EUT. For example, EUT does not explain Allais' Paradox on framing effects or loss aversion.

Due to the limitations of EUT, several alternatives have been developed, with the most notable being PT (Kahneman and Tversky, 1979). One of the key differences between PT and EUT is that the first integrates the loss aversion aspect of risk behaviour into the utility function. The other key issue is how the theories account for non-linear probabilities. PT allows transforming objective probabilities into decision weights by using a probability weighting function (see e.g., Tversky and Fox, 1995, or Tversky and Kahneman, 1992). Probability weighting and loss aversion can have important implications for placing value on typically uncertain effects of environmental policies and interventions.

A variety of methods have been developed to elicit individual risk preferences. So far, none of them has emerged as the standard approach.[2] Experimental studies have recently gained prominence. One of the most commonly used experimental risk elicitation methods is the multiple price list (MPL), originally proposed by Binswanger (1980, 1981). In this approach individuals are asked to make choices between different lotteries. This approach has been popularized by Holt and Laury (2002) who, assuming that EUT applies, used it to estimate risk parameters. In their study, individuals made ten choices between two lotteries. For each lottery, payoffs were fixed, but the probabilities varied. Rewards were structured such that one lottery was less risky than the other. To estimate risk preferences, the expected gains in two subsequent choices were compared, assuming that the relative risk aversion functional form was constant. As pointed out by Mason et al. (2005), MPLs have been mainly employed for gains rather than losses.

Tanaka et al. (2010) extended the MPL design by allowing for the estimation of empirical specifications that nest both EUT and PT to test which theory better describes the data. They asked individuals to make choices in three series of paired lotteries. Making strict assumptions regarding the functional form, Tanaka et al. were able to estimate the following three parameters within the PT framework: probability weighting parameter, value function curvature and loss aversion parameters. This design has been applied inter alia by Nguyen and Leung (2009) and Liu (2013) who showed that less educated people are also able to understand MPL with paired lotteries.[3]

The MPL approach is generally used to elicit risks in the financial domain. However, some authors have used the approach to measure risk preferences in other domains, including the environmental domain. The environmental lotteries depict nonmonetary states of nature rather than monetary gains and losses. Cherry et al. (2003), for example,

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[1] The economic theory of risk aversion is only well established for financial risks (Dyer and Sarin, 1982). To directly compare risk preferences across domains would require strong assumptions of theoretical transferability which have as yet not been established. This problem exists in all studies comparing risks in different domains. Therefore, while empirical comparisons can be made, any inferences are by definition quite tentative.

[2] Chetan et al. (2010) or Charness et al. (2013) provide reviews of different risk preference elicitation methods.

[3] Robustness of the MPL design that elicits respondents' stated preferences was investigated in a few studies. After controlling for order effect, both Harrison et al. (2005) and Holt and Laury (2005) found that scaling up real payments resulted in significantly higher levels of risk aversion, but it had no impact on hypothetically elicited risk aversion coefficients. Considering the risk elicitation format itself (i.e., the MPL), Anderson et al. (2007) found it to be robust to framing effects. Several other studies have investigated links between risk preferences elicited using the experimental approach and real-world risky behaviours. Anderson and Mellor (2008), for example, showed that individuals who are more risk averse are less likely to smoke and more likely to wear seat belts, and Lusk and Coble (2005) found that risk preferences are significant determinants of acceptance of genetically modified food.